

Light Metal Propellant Hall Thruster, Phase I

Completed Technology Project (2009 - 2009)



Project Introduction

Busek proposes to develop light metal Hall Effect thrusters that will help reduce the travel time, mass, and cost of SMD spacecraft. Busek has identified three attractive light metal propellants: magnesium (Mg), zinc (Zn), and a eutectic (Mg/Zn). These metals are plentiful and practical alternatives to Xe and Kr, which are expensive and scarce, and Bi, which is overly condensable and requires a high voltage power processing unit (PPU) to reach velocities of interest. Because Mg and Zn are lightweight, specific impulse > 3000 s will be available with a near term, low voltage PPU, decreasing propellant mass and program and hardware costs. Both metals have favorable ionization properties, implying high efficiencies are possible. Mg can also be combusted with water in a rocket, enabling a multi-mode propulsion system where the Hall thruster and rocket share propellant. The availability of a high thrust impulsive mode can greatly decrease delta V and trip times for SMD spacecraft. These light metals are non-toxic and solid at room temperature. They can be stored and fed to a thruster as a wire. For Zn and Mg/Zn, liquid distribution is also feasible. Life testing will be low cost because the light metals are inexpensive and self pumping; they will condense on the vacuum chamber wall. Vapor pressure curves suggest minimal spacecraft interactions. In-situ propellant production is also possible. Mg, for example, can be extracted from Martian regolith using solar energy. The key innovation in this proposal is the use of light metals to fuel a Hall thruster. In Phase I, Busek will design and demonstrate a wire based light metal feed system that will be integrated with an existing 1-2 kW bismuth vapor Hall Effect thruster. Busek will then demonstrate a Mg, Zn, or Mg/Zn discharge and measure its operating parameters. Finally, Busek will lay out a dedicated thruster and feed system to be built and tested in Phase II.



Light Metal Propellant Hall Thruster, Phase I

Table of Contents

Project Introduction	1
Organizational Responsibility	1
Primary U.S. Work Locations and Key Partners	2
Project Management	2
Technology Areas	2

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

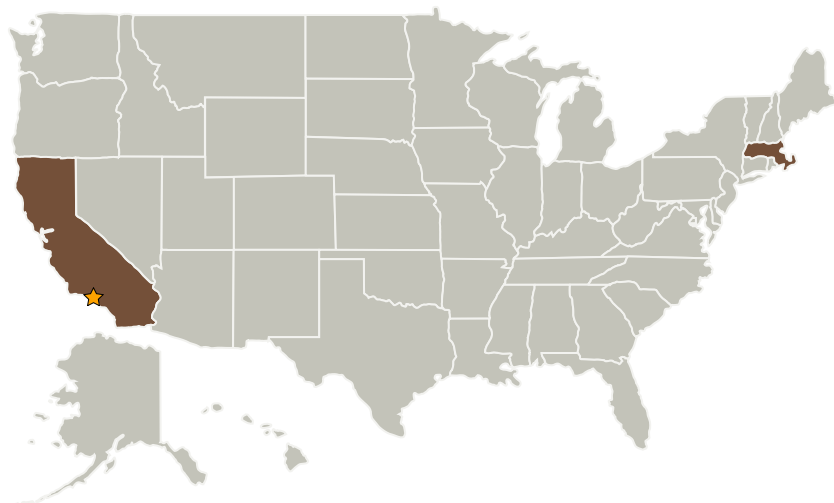
Small Business Innovation Research/Small Business Tech Transfer

Light Metal Propellant Hall Thruster, Phase I

Completed Technology Project (2009 - 2009)



Primary U.S. Work Locations and Key Partners



Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.2 Electric Space Propulsion
 - └ TX01.2.2 Electrostatic

Organizations Performing Work	Role	Type	Location
★ Jet Propulsion Laboratory (JPL)	Lead Organization	NASA Center	Pasadena, California
Busek Company, Inc.	Supporting Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts

Primary U.S. Work Locations

California	Massachusetts
------------	---------------